SEE Test Plan/Report V1.0

Heavy Ion SEL Test of MAX367 andDG390 from Maxim

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I. Introduction

A study was undertaken to determine the destructive single event susceptibility of the MAX367 circuit protector and DG390 switch, which are used in the Hubble Space Telescope Advanced Camera system. These devices are commercial CMOS, and so single-event latchup (SEL) may be a concern. The devices were assessed only for susceptibility to SEL and other destructive mechanisms. As such, the devices may still have some susceptibility to single-event upsets and transients (SEU and SET). Additional testing may be needed for applications where nondestructive SEE are critical.

II. Devices Tested

The test sample size is 3 devices for each part type. The devices were delidded, mounted on a wire-wrap circuit board that supplied the correct biases and loads . (Lot #). The DG390 is a Single-Pull, Single-Throw CMOS analog switch manufactured by Maxim Integrated Products (MIP). The MAX367 from MIP is a CMOS signal-line circuit protector designed to prevent exposure of sensitive components to overvoltage conditions. The device was prepped for test by delidding & then incorporated into the target circuit assembly.

III. Test Facility

Facility

Texas A&M University Cyclotron Single Event Effects Test Facility (TAMU)

Flux

1 x 10^3 to 7 x 10^4 particles/cm^2/s.

Fluence

All tests shall be run to 1 x 10^6 p/cm^2 or until a sufficient (>100) number of transient events occurred. The ions and LET values planned for these tests used TAMU's 15 MeV/amu tune and are shown in Table 1.

Table 1: Ion an LET and range values at target for 0 degree incidence

Ion-energy (MeV)	LET (MeV•cm^2/mg)	Range (μm)
Ag-1634	53.1	156

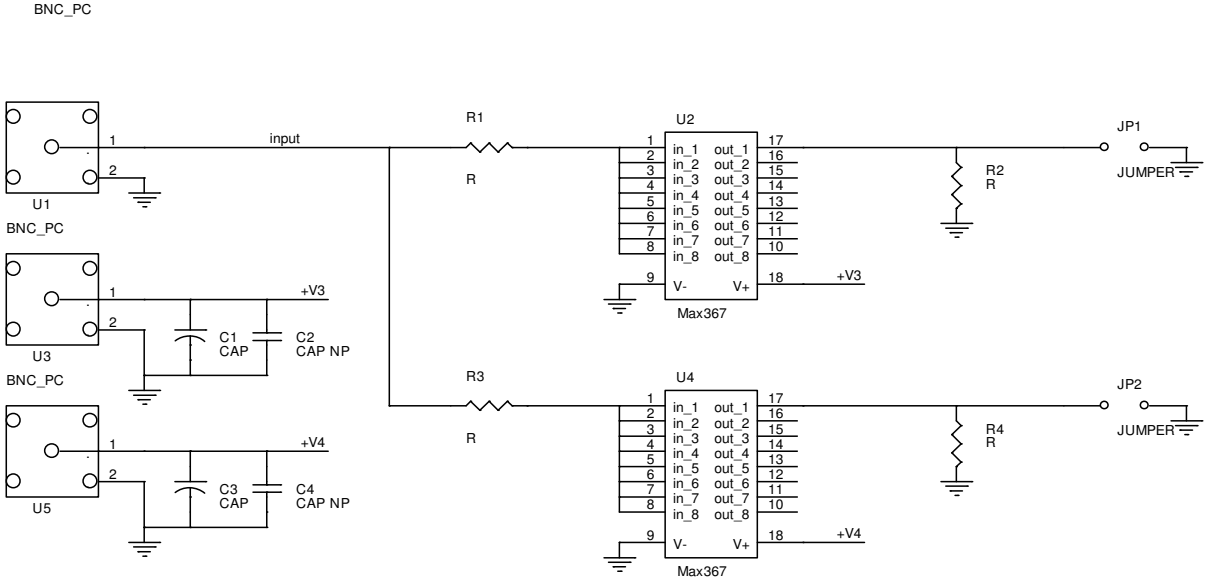
IV. Test Conditions and Error Modes

Test Temperature

Tests were conducted at both room temperature and 80 degrees C.

Bias conditions

The MAX367 and the DG390 were biased as in Figures 1 and 2, respectively.

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Ch 1 -> +V4 (4v input)
Ch 3 -> +V3 (10V Dut 1 power)
Ch 4 -> +V3 (10V Dut 2 power)
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Figure 1 Schematic for MAX367 Circuit protector SEL test.

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Nominal current = 10ma (dut power ch 3 & 4)
    +V1= 5V (relay power/5v=dut1/0v=dut2)
    +V2= 4V (signal source)
    +V3= 15V (+Dut Power)
    -V4= 15V (-Dut Power)
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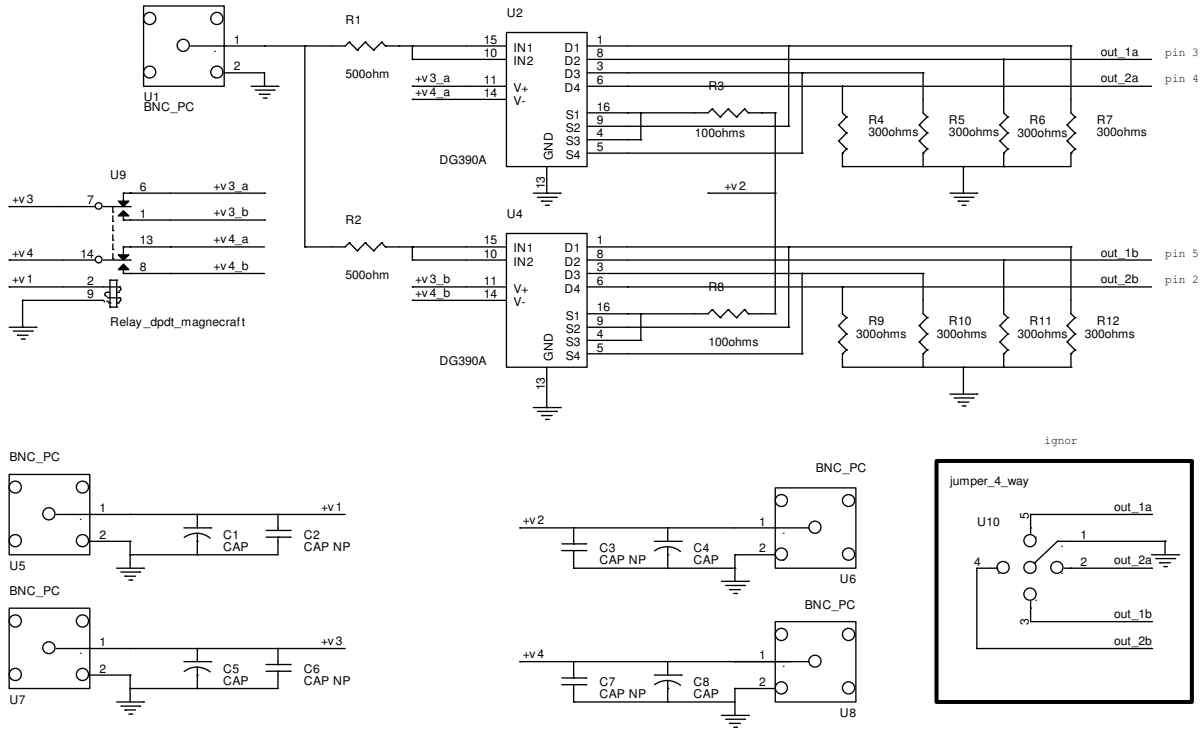


Figure 2 Schematic for DG390 Circuit protector SEL test.

SEE Conditions

SEL, SET (large only)

V. Test Method

The test board was placed in line with the beam and the part was centered in the beam. Part functionality was verified, and the part was irradiated to a flux of 10^7 ions per cm^2, or until destructive failure was observed. For both parts, the output was observed on the oscilloscope for any obvious indications of transient or permanent upset.

Block Diagram

The teest setup for the MAX367 is shown in Figure 3 and that for the DG390 in Figure 4. Output of the devices was monitored on a digital scope to capturing any output anomalies. Instrument control and instrument test data acquisition is established via the GPIB.

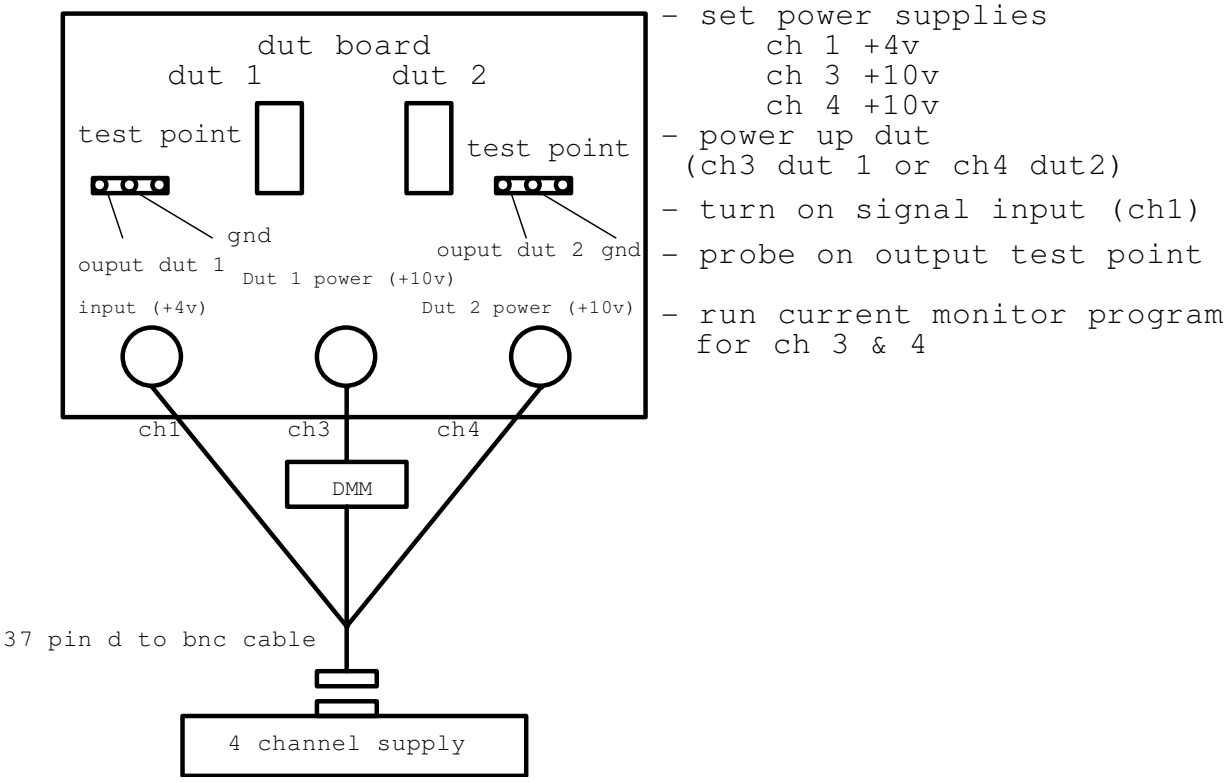
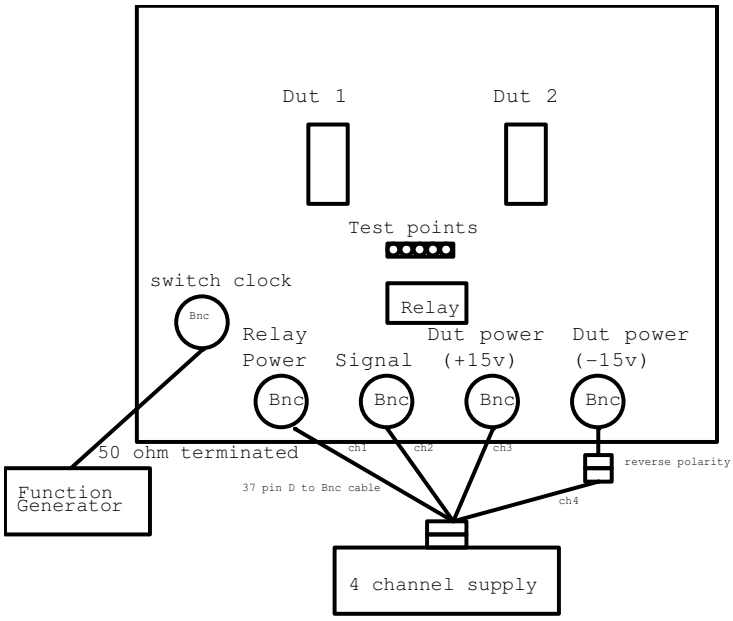


Figure 3. Test Set-up for the MAX367.



Test Procedure

- set power supply
  ch 1 = +5V .2A
  ch 2 = +4V
  ch 3 = +15V
  ch 4 = -15V
- set Function generator
  5V pp /2.5v ref/1Mhz
- Turn on PS and FG
- Select Dut 1 or Dut 2
  monitor Dut 1 output
  w/ probe (pin 3 & 4)
  Scope Gnd = pin 1
- run current monitor program
  monitor Dut 2 output
  with probe (pin 5 & 2)
- Set Latchup currents
  to 10ma on ps ch 3 & 4
  PS channel 1 selects
  dut (on=dut1/off=dut2)

Notes

* nominal currents :
  ch1 .11a
  ch1 >1ma
  ch3 10ma @ 1Mhz switching freq (>1uA @ static)
  ch4 10ma
* Latchup current settings :
  ch3 20ma
  ch4 20ma

Figure 4. Schematic Diagram for the testing of the DG390

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VI. Test Results

No destructive events or other anomalies were observed up to the highest effective LET tested of 87.6 MeVcm^2/mg (Ag ions @ 15 MeV/amu with LET 43.8 MeVcm^2/mg incident at 60 degrees to the Normal). Testing was also conducted with the same beam at normal incidence to ensure that the parts were not vulnerable to failure modes such as SEBR/SEB and that ion penetration was adequate. All tests were conducted to an effective fluence of 1E7 ions per cm^2. This suggests that the failure rate is less than 10^{-8} per device day.

In addition, no obvious SET were seen for either device at the crude resolution available for the experiment.

These devices exhibit no destructive single-event effects. However, they are susceptible to single-event transients.